Claims

1. Device for determining the position for a working part of a tool on a working machine with a position-determining apparatus (1,4,5a,5b,6;1,4a,4b,5a,5b,6; 31,33; 49,50,51,1',53) comprising at least one detector equipment (4,5a,5b,6; 4a,4b,5a,5b,6; 31,49,50,51,53) placed at a designated place on the working machine (3;52) in order to determine the position of this place in a fixed coordinate system, and with at least one position relationship device (11) in order to determine the positional relationship of the working part relative to the detector equipment in a machine-based coordinate system, and a calculating device (20) which with signals from the position-determining apparatus and the positional relationship device calculates the position of the working part in the fixed coordinate system, **characterized** in that the position-determining apparatus comprises an inclination- and orientation-measuring device (5a,5b,20;4a,4b,20;31,20;51,20) so that the apparatus instantaneously measures both the position as well as the orientation of said place on the working machine in the fixed coordinate system, and that the calculating device (20) converts the measuring result from the position-determining apparatus and the positional relationship device in order to give the instantaneous position and/or orientation of the working part in the fixed coordinate system.

2. Device according to Claim 1, **characterized** in that the position-determining apparatus comprises at least one detector unit (4), fixedly placed on the working machine, and a north-seeking unit (5b), such as a north-seeking gyroscope or an electronically readable compass, for instantaneous sensing of the direction of the working machine in relation to north.

3. Device where the position-determining apparatus comprises a stationary measuring station (1;1') placed in the vicinity of the working machine for determining the position in cooperation with the detector device, in accordance

with Claim 1, **characterized** in that the position- and orientation-determining apparatus comprises either at least two detector units (4a,4b) arranged in fixed positions relative to the working machine, which in cooperation with the stationary station give positions fixed in space for their placements and the mutually measured positions of which give the orientation in space for the part of the working machine where they are placed, or at least one movable detector unit (33;50) movable between positions with determinable positions in relation to the working machine.

4. Device according to Claim 3, **characterized** in that the position detector unit (33;50) is rotatable around an axis (32) placed at a distance therefrom in relation to the working machine, whereby measurement towards the position detector unit is indicated when it reaches determined angular positions around the axis in relation to the working machine.

5. Device according to Claim 1, **characterized** by at least one rotatably mounted and controllable optical unit (26-28,23) placed on the working machine, which optical unit aligns itself towards the stationary measuring station with the help of either the measuring beam of the stationary station or a beam parallel with this beam or a beam transmitted from the optical unit and reflected in a prism in the stationary station, whereby the orientation of the optical unit relative to the working machine is indicated and transmitted to the calculating unit (20) for determination of the orientation of the working machine in the fixed coordinate system.

6. Device according to ~~any of the previous claims~~ Claim 1, **characterized** in that each position detector unit is at least one radio navigation antenna (50,53) with receiver.

7. Device according to ~~any of Claims 1-5~~, **characterized** in that the position-determining apparatus comprises a geodesic instrument (1;1') with target-seeking function, placed at a distance from the working machine (3) and measuring against at least one target, e.g. a reflector, on the working machine.

8. Device according to Claim 7, **characterized** in that each target (4a,4b) is provided with an alignment indicator (12,13), which gives alignment indications for the geodesic instrument concerning the target towards which its instantaneous target-seeking is to be made and for measuring towards this target.

9. Device according to ~~any of the previous claims~~, **characterized** in that the calculating device (20) is provided with a stored map with the desired topography of an area which is to be treated, and calculated data for the working part for position and angular positions relative to the map are presented on a presentation unit (9) (Fig. 8).

10. Device according to ~~any of the previous claims~~, **characterized** in that the position- and orientation-determining apparatus comprises partly a relatively slow, accurate determining device (1,4;1,4a,4b;53,50,51), which at time intervals accurately measures the actual position and orientation of the machine, and partly a relatively slow fast determining device (ACC;ACC1,ACC2;6), which reacts on position and/or orientation differences to earlier determination or determinations in order to calculate and update the determination between the said time intervals.

11. Device according to Claim 10, **characterized** in that the relatively fast determining device comprises at least one accelerometer device (6;ACC1; ACC1,ACC2) on the machine for measuring the acceleration of the machine in at least one direction, preferably in several mutually different directions, whereby the calculating unit (20) integrates the indicated acceleration(s) and updates the latest calculation result of the position in the fixed coordinate system.

12. Device according to Claim 10, **characterized** in that the relatively fast determining device comprises at least one rotation-indicating device (6) for rotation around at least one axis of the machine.

13. Device according to ~~any of the previous claims~~ Claim 1, **characterized** in that the calculating unit (20) uses earlier calculation results to calculate the probable position, orientation, direction of work and speed a certain time in advance for the working part of the working machine.

14. Method for determining the position for a working part of a tool on a working machine, whereby the position of the working machine is determined in at least one defined place on the working machine in a fixed coordinate system, at the same time as the positional relationship relative to the defined position is determined in a machine-based coordinate system, and the position of the working part is calculated in the fixed coordinate system, **characterized** by measuring instantaneously both the position and the orientation of said position on the working machine in the fixed coordinate system, and calculating of the instantaneous position and/or orientation in the fixed coordinate system with the help of the result of the instantaneous measurement.

15. Method according to Claim 14, **characterized** by fixed placement on the working machine of at least one detector unit (4) and a north-seeking unit (5b), such as a north-seeking gyroscope or an electronically readable compass for instantaneous sensing of the direction of the working machine in relation to north.

16. Method, where the position-determination takes place with the help of a stationary measuring station (1;1') placed in the vicinity of the working machine for determining the position in cooperation with the detector device, according to Claim 14, **characterized** in that the position- and orientation-determination takes place either against at least two detector units (4a,4b) placed in fixed positions

relative to the working machine which in cooperation with the stationary station gives positions fixed in space for their positions and the mutually measured positions of which give the orientation in space for the part of the working machine where they are placed, or against at least one movable position detector unit (33;50), which can move between positions with defined positions in relation to the working machine.

17. Method according to Claim 16, **characterized** by rotation of the position detector unit (33;50) around an axis (32) placed at a distance from it in relation to the working machine; measuring against the position detector unit when it takes up determinable angular positions around the axis in relation to the working machine.

18. Method according to Claim 14, **characterized** by rotatable mounting of at least one controllable optical unit (26-28,23) on the working machine; alignment of the optical unit to the stationary measuring station with the help of either the measuring beam of the stationary station or a beam parallel with this beam or a beam transmitted from the optical unit and reflected in a prism on the stationary station; indication of the orientation of the optical unit in relation to the working machine; calculation for determining of the orientation of the working machine in the fixed coordinate system.

19. Method according to ~~any of Claims 14-18~~ claim 14, **characterized** in that the instantaneous measuring of both position and orientation is performed with the help of at least one radio navigation antenna (50,51) with receiver.

20. Method according to ~~any of Claims 14-18~~ claim 14, **characterized** in that the instantaneous measuring of both position and orientation is performed with the help of a geodesic instrument (1;1') with target-seeking function, placed at a

distance from the working machine (3) and measuring against at least one target, e.g. a reflector, on the working machine.

21. Method according to Claim 20, **characterized** by direction-indication for the geodesic instrument as to the target towards which its instantaneous target-seeking is to be performed for measuring against this target.

22. Method according to ~~any of Claims 14-21~~, **characterized** by storing of a map with desired topography of a region which is to be processed in a calculating device, and calculating of data for the working part and presentation thereof as position and angular positions relative to the map, on a presentation unit (9) (Fig.8).

23. Method according to ~~any of the previous claims~~, **characterized** in that the position and orientation determination is performed partly with a relatively slow determination in order to measure, at time intervals, the actual position and /or the orientation of the machine, and partly with a relatively fast determination (ACC1, ACC2,6), which reacts to position and/or orientation differences relative to earlier determination(s) in order to calculate and update the determination between the said time intervals.

24. Method according to Claim 23, **characterized** by, at the relatively fast determination:

acceleration-measuring in at least one direction, preferably in several mutually different directions;

integration of the indicated acceleration(s); and

updating of the latest calculation result of the position and/or the orientation in the fixed coordinate system.

25. Method according to Claim 23, **characterized** in that, at the relatively fast determination, at least one rotation-indication is performed for rotation around at least one axis of the machine.

26. Method according to ~~any of Claims 14-15~~ claim 14, **characterized** by calculation, with the help of earlier calculation results, of probable position, orientation, working direction and speed a certain time in advance for the working part of the working machine.